

Design and Evaluation of SOCR Tools for Simulation in Undergraduate Probability and Statistics Courses

It's Online, Therefore It Exists!



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www.SOCR.ucla.edu

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Outline

- What is SOCR?
- Demonstrations
 - Experiments
 - Activities (wiki)
- Design of Study
 - Results
- Future Research and Development

What is SOCR?

 **SOCR: Statistics Online Computational Resource - Netscape**

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 <http://www.socr.ucla.edu/>

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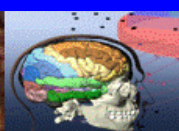
[Games](#)

[Modeler](#)

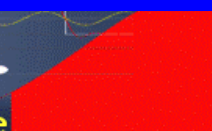
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Statistics Online Computational Resource



[SOCR News, Events, Announcements](#) [SOCR/CAUSEway 2007 Workshop](#) *It's online, therefore it exists!*

What is SOCR?

The goals of the SOCR Resource are to design, validate and freely disseminate knowledge. Our Resource specifically provides portable online aids for probability and statistics education, technology based instruction and statistical computing. SOCR tools and resources include a repository of interactive applets, computational and graphing tools, instructional and course materials.



INTERACTIVE SOCR TOOLS

[SOCR Distributions](#)
[SOCR Experiments](#)
[SOCR Analyses](#)
[SOCR Games](#)
[SOCR Data Modeler](#)
[SOCR Plots & Charts](#)

Demonstrations

- Poker
- Roulette
- Die coin
- Central limit theorem
- Confidence intervals

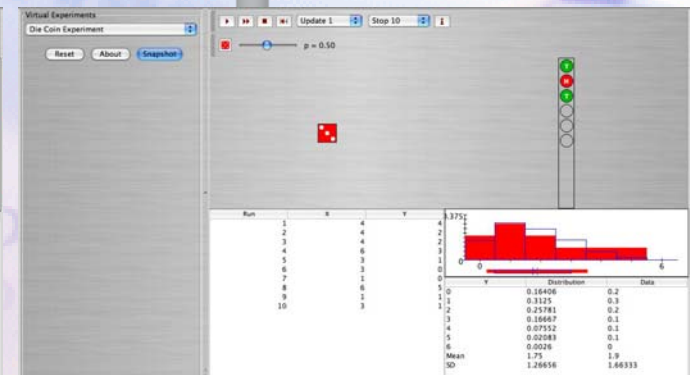
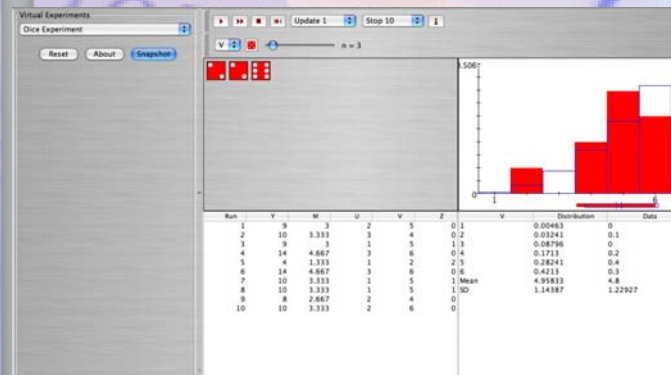
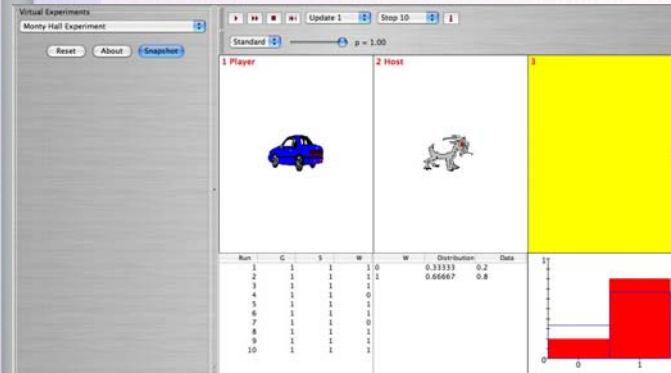


<http://www.socr.ucla.edu/>

Experiments

FEATURES

- 60+ Experiments
- Simulations
- Summary Stats
- Model vs. Sample

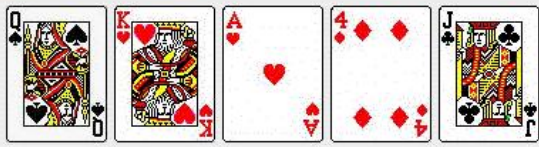


Poker

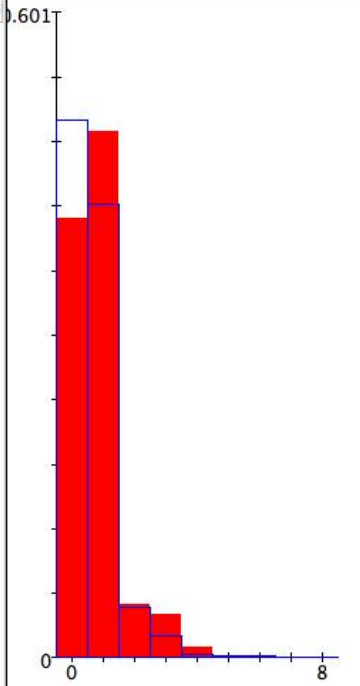
Virtual Experiments
Poker Experiment

Reset Help About Snapshot

Update 1 Stop 100



Run	V	V	Distribution	Data
1	0	0	0.50118	0.41
2	0	1	0.42257	0.49
3	0	2	0.04754	0.05
4	1	3	0.02113	0.04
5	2	4	0.00393	0.01
6	1	5	0.00197	0
7	1	6	0.00144	0
8	1	7	0.00024	0
9	4	8	0.00002	0
10	1			
11	1			
12	1			
13	2			
14	0			
15	1			
16	1			
17	1			
18	0			
19	3			
20	1			
21	0			
22	1			
23	0			
24	0			
25	2			
26	1			
27	1			
28	0			
29	0			
30	1			



Roulette

Virtual Experiments

Roulette Experiment

Reset

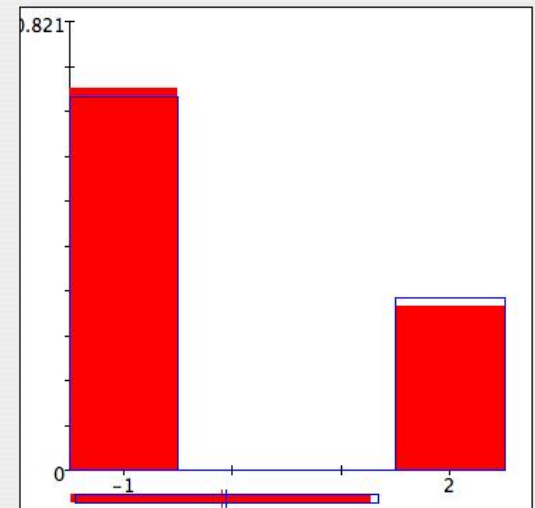
Help

About

Snapshot

Update 1 Stop 100

Bet on 1-12



Run	X	W	Distribution	Data
1	10	2	0.68421	0.7
2	32	-1	0	0
3	10	2	0	0
4	13	-1	0.31579	0.3
5	2	2	-0.05263	-0.1
6	34	-1	1.39449	1.3817
7	2	2		
8	26	-1		
9	15	-1		
10	24	-1		
11	4	2		
12	25	-1		



Die coin

Virtual Experiments
Die Coin Experiment

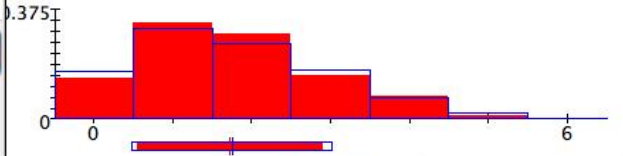
Reset Help About Snapshot

Update 1 Stop 100

$p = 0.50$

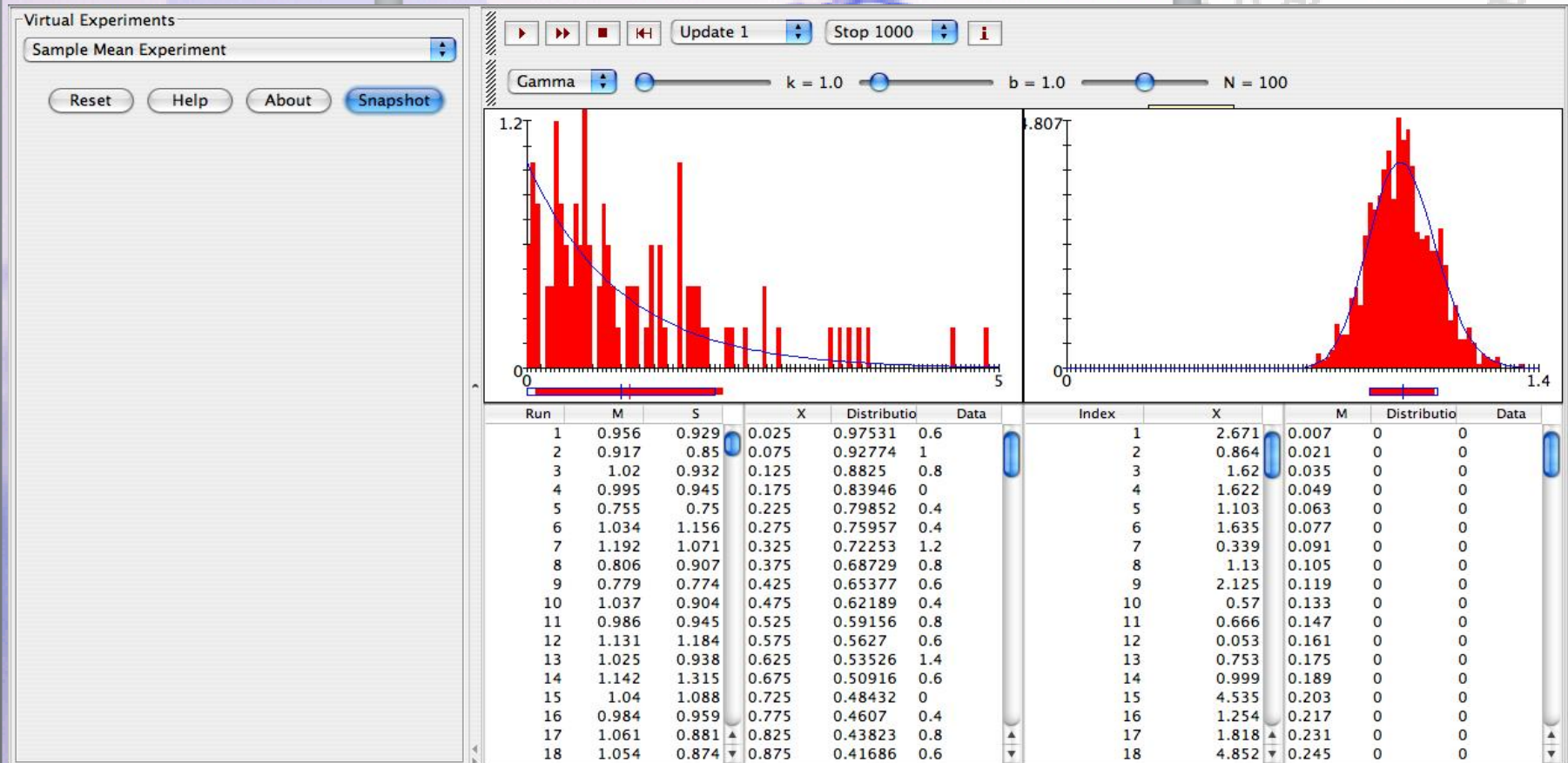


Run	X	Y
1	6	2
2	6	4
3	4	0
4	1	1
5	3	1
6	4	1
7	3	1
8	1	1
9	4	2
10	1	1
11	1	0
12	2	2
13	4	2
14	5	3
15	5	3
16	1	1
17	6	3



Y	Distribution	Data
0	0.16406	0.14
1	0.3125	0.33
2	0.25781	0.29
3	0.16667	0.15
4	0.07552	0.08
5	0.02083	0.01
6	0.0026	0
Mean	1.75	1.73
SD	1.26656	1.17941

Central limit theorem



Confidence intervals

Virtual Experiments

Confidence Interval Experiment

Reset Help About Snapshot

Step Run Stop

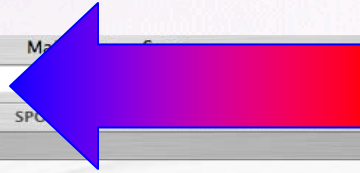
Result Report Freq: 1 Number of Experiments: 10

alpha = 0.05 20 Sample Size 100 Number of Intervals

Experiment	Missed Intervals:
0	0
1	

Activities

http://wiki.stat.ucla.edu/socr/index.php/Main_Page



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search

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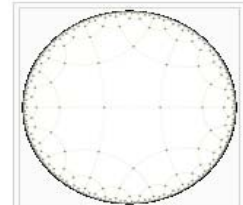
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Main Page

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Interactive SOCR Resource Viewer [↗](#)

■ [SOCR Home page: http://www.socr.ucla.edu](http://www.socr.ucla.edu) or <http://www.StatisticsResource.org>

Translate this page:

(default)	Deutsch	Español	Français	Italiano	Português	日本語
한국어	中文	繁体中文	Русский	Nederlands	Ελληνικά	



Go to "http://wiki.stat.ucla.edu/socr/index.php/Main_Page"

Educational Materials

SOCR EduMaterials - Socr

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SOCR EduMaterials

SOCR Wiki - SOCR Activities [edit]

- SOCR Distributions Activities
- SOCR Experiments Activities
- SOCR Analyses Activities
- SOCR Games Activities
- SOCR Modeler Activities
- SOCR Charts Activities
- SOCR General Activities
- SOCR Course Specific Activities

SOCR Wiki - Educational Materials [edit]

- SOCR Wiki Editing Guideline
- SOCR Courses
- SOCR Surveys
- SOCR Instructor Plans
- SOCR AP Statistics Curriculum (E-Book)
- SOCR Evaluations
- SOCR Brochure
- SOCR Home page: <http://www.socr.ucla.edu>

Translate this page:



navigation

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Go Search

toolbox

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SOCR Experiments Activities

SOCR EduMaterials ExperimentsActivities - Socr

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SOCR EduMaterials ExperimentsActivities

SOCR Educational Materials - Experiments Activities [edit]

- SOCR Ballot Experiment
- SOCR Ball And Urn Experiment
- SOCR Bertrand Experiment
- SOCR Beta Coin Experiment
- SOCR Beta Estimate Experiment
- SOCR Binomial Coin Experiment
- SOCR Binomial Timeline Experiment
- SOCR Birthday Experiment
- SOCR Bivariate Normal Experiment
- SOCR Bivariate Uniform Experiment
- SOCR Buffon Coin Experiment
- SOCR Buffon Needle Experiment
- SOCR Card Experiment
- SOCR Chi Square Dice Experiment
- SOCR Chuck A Luck Experiment
- SOCR Coin Die Experiment
- SOCR Coin Sample Experiment
- SOCR Confidence Interval Experiment
- SOCR Coupon Collector Experiment
- SOCR Craps Experiment
- SOCR Dice Experiment
- SOCR Dice Sample Experiment
- SOCR Die Coin Experiment
- SOCR Finite Order Statistic Experiment
- SOCR Galton Board Experiment
- SOCR Gamma Estimate Experiment
- SOCR Gamma Experiment
- SOCR Law Of Large Numbers Experiment

Done

SOCR Distributions Activities

SOCR EduMaterials DistributionsActivities - Socr

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SOCR EduMaterials DistributionsActivities

SOCR Educational Materials - Distribution Activities [\[edit\]](#)

- [SOCR Binomial, Geometric, Hypergeometric Distributions Activity](#)
 - [SOCR Continuous Distributions Activity](#)
 - [SOCR Exponential Distribution Activity](#)
 - [SOCR General Central Limit Theorem](#)
 - [SOCR Negative Binomial Distribution Activity](#)
 - [SOCR Normal Distribution Activity](#)
 - [SOCR Poisson Distribution Activity](#)
 - [Explore relationships among distributions](#)
 - [Discrete Probability Distributions-examples](#)
 - [Normal Probability Distribution-examples](#)
 - [Central Limit Theorem and Chi-Square examples](#)
 - [More examples on distributions](#)
-
- [SOCR Home page: http://www.socr.ucla.edu](http://www.socr.ucla.edu)

Translate this page:



Design of study

Population

Lower division:

- 4 classes
- 2 control
- 2 treatment
- > 300 students

Upper division:

- 4 classes
- 1 control
- 1 treatment
- 2 cross-over
- > 120 students

Duration

- 3 times/per week with instructor
- 1 hour discussion (upper division)
- 1 hour discussion + lab (lower division)

Data collected

- Satisfaction
- Attitude surveys
- Learning styles
- Exam scores

Felder-Silverman-Soloman LSI

Four categories

I: Active/Reflective

II: Sensing/Intuitive

III: Visual/Verbal

IV: Global/Sequential

Students take an online questionnaire of 44 questions

Each category has 11 questions

Each question has two answers (a, b)

Answer “a” gets the value -1, “b” gets the value +1

$0 \leq \text{ABS}(\text{LSI}) \leq 3$

Balanced

$4 \leq \text{ABS}(\text{LSI}) < 7$

Moderate

$7 \leq \text{ABS}(\text{LSI}) \leq 11$

Strong

Example: Category I

1 2 3 4 5 6 7 8 9 10 11

a a b a a a a a a a a

Total score: -9

Strong Active

UCLA Royce Hall



Basilica di Sant'Ambrogio, Milan



Results

- Some group differences are significant
- Some Felder-Silverman LSI dimensions are significant
- Higher level of student engagement (informal)
- Students' satisfaction

Results

Table 1: Quantitative results measuring student learning in the two Stats 100A classes (Christou, Fall 2005, Fall 2006)

	Group	High	Low	Median	Mean	Standard Deviation	Statistics
Exam 1	Control	96	33	68	69.97	18.52	$t_o = 0.99$ $t(71)$ $p=0.17$
	Treatment	97	33	60	65.74	18.05	
Exam 2	Control	100	40	88	83.85	14.93	$t_o = 0.81$ $t(71)$ $p=0.21$
	Treatment	100	41	86	81.10	14.12	
Exam 3	Control	100	32	71	71.12	16.75	$t_o = -3.87$ $t(71)$ $p=0.0001$
	Treatment	100	58	87	83.64	10.58	
Exam 4	Control	100	36	79	78.35	16.56	$t_o = -3.20$ $t(71)$ $p= 0.001$
	Treatment	100	65	90	88.05	8.61	
Exam 5	Control	100	40	81	80.38	15.17	$t_o = -2.46$ $t(71)$ $p=0.008$
	Treatment	100	66	89	87.44	8.90	
Overall Performance	Control	94.31	44.93	78.14	78.36	12.87	$t_o = -2.16$ $t(71)$ $p=0.017$
	Treatment	98.77	66.59	85.92	83.69	7.91	

Results

Table 2: Quantitative results measuring student learning in the two Stats 13 classes (Christou, Fall 2005, Fall 2006)

	Group	High	Low	Median	Mean	Standard Deviation	Statistics
Exam 1	Control	100	44	83	81.41	14.05	$t_a = -0.63$ t(165) p=0.27
	Treatment	100	46	84	82.68	11.92	
Exam 2	Control	100	6	81	76.75	18.25	$t_a = -5.92$ t(165) p<0.001
	Treatment	100	35	95	90.86	12.19	
Exam 3	Control	100	35	85	81.61	14.58	$t_a = -0.37$ t(165) p=0.36
	Treatment	100	50	84	82.36	11.62	
Exam 4	Control	100	37	86	83.94	10.70	$t_a = 1.63$ t(165) p= 0.06
	Treatment	100	54	83	81.07	11.96	
Exam 5	Control	100	20	79	78.75	13.84	$t_a = -4.84$ t(165) p<0.001
	Treatment	100	50	91	87.80	10.02	
Overall Performance	Control	94.31	43.91	85.42	82.09	11.6	$t_a = -3.07$ t(165) p=0.001
	Treatment	97.49	69.17	88.68	86.67	7.37	

Results

Table 3: Quantitative Results measuring student learning in the two Stats 13 classes (Dinov, Fall 2005, Fall 2006).

	Group	High	Low	Median	Mean	Standard Deviation	Statistics
Homework	Control	99.89	79.71	93.89	93.10	4.01	$t_0 = -0.85$ t(157) p=0.20
	Treatment	99.22	77.61	94	93.64	3.96	
Lab	Control	99.5	78	94.8	94.14	4.32	$t_0 = -11.50$ t(157) p<0.001
	Treatment	100	96.67	100	99.83	0.64	
Midterm	Control	100	53	84.33	82.87	13.65	$t_0 = -0.58$ t(157) p=0.28
	Treatment	99	60	84.5	83.93	8.73	
Final	Control	100	42	83	80.17	16.13	$t_0 = 0.13$ t(157) p= 0.45
	Treatment	97	38	83	79.88	12.36	
Overall Performance	Control	96.89	53.60	86.77	83.65	12.33	$t_0 = -1.71$ t(157) p=0.045
	Treatment	97.52	68.29	87.06	86.37	6.50	

Results

Regression results for the LSI effects on the overall quantitative performance for Stats 13 (Christou)

Source		SS	df	MS	Number of obs =	72
Model		956.969029	3	318.989676	F(3, 68) =	5.33
Residual		4070.82122	68	59.865018	Prob > F =	0.0023
Total		5027.79025	71	70.8139472	R-squared =	0.1903
					Adj R-squared =	0.1546
					Root MSE =	7.7372

tot		Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
s1		.5947788	.2680462	2.22	0.030	.0599009	1.129657
s3		-.7596321	.2883656	-2.63	0.010	-1.335057	-.1842076
post		.504371	.2254381	2.24	0.029	.0545162	.9542258
_cons		67.50669	8.583663	7.86	0.000	50.37826	84.63512

Future Research & Development



- Classroom testing for the effectiveness of SOCR (2005-06, 2006-07)
- New tools under development
- More SOCR activities for Wiki page
- Annual SOCR Workshops at UCLA in August

Live web streaming available at:

wiki.stat.ucla.edu/socr/index.php/SOCR_Events_Aug2007



- SOCR usage: www.SOCR.ucla.edu
- National Internet-based Science Educational resource: www.NSER.org



SOCR Acknowledgments

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www.SOCR.ucla.edu
www.StatisticsResource.org



Collaborators

I Dinov, N Christou, J Sanchez, R Gould, J Cui, A Che, A Anderson, P Chui, R Gidwani